## Related Appeals And Interferences

No other appeals or interferences are known to the Appellants, the Appellants' legal representative, or the Assignee which will directly affect or be directly affected by or have a bearing on an appeal.

## Status Of Claims

| | |
|---|---|
| Originally filed claims: | 1-23 |
| Cancelled claims: | none |
| Presently pending claims: | 1-26 |
| Allowed claims: | 1-9 |
| Rejected claims: | 10-12, 14, 17 and 19-23 |
| Claims objected to: | 13, 15, 16, 18 |
| Claims being appealed: | 10-12, 14, 17 and 19-26 |

## Status Of Amendments

An amendment is filed concurrently herewith to amend claims 13 and 18 and add claims 24-26.

## Summary of Invention

The following summary of the invention is meant to be a concise explanation of embodiments for the invention provided in the application. By its nature, it does not contain all the detail provided in the application; full appreciation for aspects and nuances of the invention should be determined by reference to the application. This summary also may contain detail or variants not required by any given claim; the claims define the scope of the invention and each claim's patentability should be

determined on its own merits.

As admitted in the Background of the Invention, Ultrasonic Gas Flow meters have been developed to determine how much gas flows through a pipeline. (1/003).[1] These gas flow meters include pairs of ultrasonic transceivers, meaning they both generate and receive ultrasonic signals, as shown below with reference to Figure 1a of the application. (2/005).

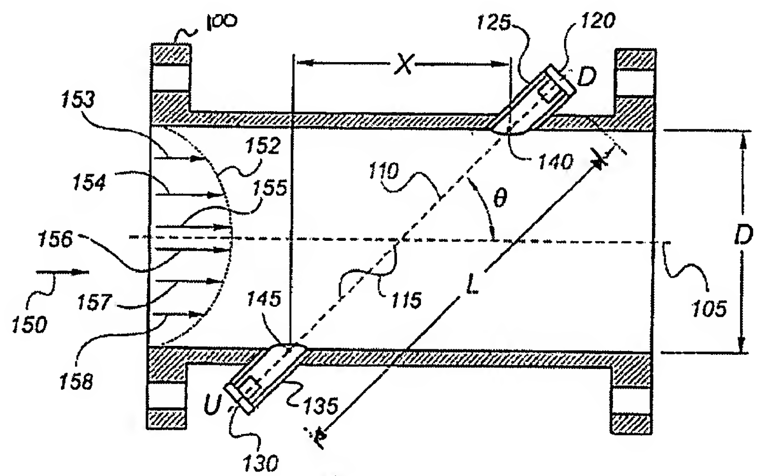
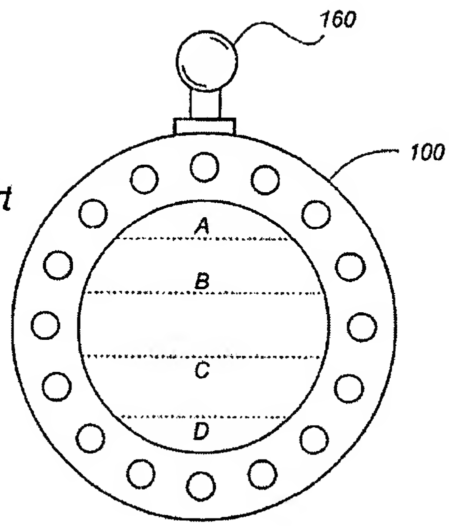



Fig 1a
*Prior Art*

With reference to Figure 1a (above), each pair of the signals 115 are generated and received by a piezoelectric element in each transducer 120, 130. *Id.* To generate an ultrasonic signal the piezoelectric element is excited electrically. *Id.* An ultrasonic signal than travels to a corresponding transducer, where it excites another piezoelectric element to vibrate and generate a received waveform. *Id.* A typical ultrasonic meter has four chords, corresponding to eight transducers (5/0013). For the Examiner's convenience, Figure 1b from the application is included below.

[1] - (1/003) refers to page 1, paragraph 003 of the original specification.

Fig 1b
*Prior Art*




One ultrasonic signal is transmitted upstream and its travel time measured, while the other is transmitted downstream with its travel time being measured. Because the measurement of gas flow velocity and speed of sound depend on measured transit times, it is important to measure transit time accurately (6/0016). Various measurement errors known to those of ordinary skill the art, however, can arise from a number of causes such as noise or perturbations in the flow profile. Another error that can arise is from the process of defining exactly when an ultrasonic waveform is received. (6/0017). For example, a detected waveform corresponding to a received ultrasonic signal may look like that shown in Figure 2, below.

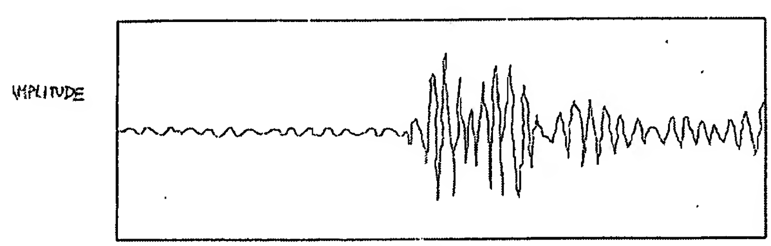



Figure 2

As can be appreciated, the precise instant this waveform is deemed to have arrived is not

altogether clear (6/017). Some approaches identify a particular peak or zero crossing of the waveform and declare it as the arrival instant of the waveform (6/017), dynamically adjusting various criteria from waveform to waveform (7/018). Nonetheless, these approaches still suffer from arrival time misidentification, using the wrong peak or zero crossing as the arrival time (7/018). Such misidentifications are referred to as peak switch errors (7/018).

The invention determines whether an arrival time misidentification error is present,[2] and can also determine the size of that error. Generally, the waveform is analyzed according to the following principles. For a chord A of known length $L_A$, it is known that an ultrasonic wave traveling at the speed of sound "c" through a homogeneous medium at zero flow in the meter traverses the length of the chord $L_A$ in transit time, $t_A$ (9/0023). It follows for chord A that:

$$c = \frac{L_A}{t_A} \qquad (1)$$

(9/0023). This is just as true for a second chord, chord B. (9/0023).

For various reasons, however, the measured gross transit time is not exactly the actual transit time of the signal. One reason, for example, that the two times differ is the delay time inherent in the electronics associated with each transducer (9/0024).

Total measured time T may then be defined as:

$$T = t + \tau \qquad (2)$$

where,

$T$ = measured or gross transit time;

$t$ = actual transit time; and

$\tau$ = delay time.

(9/0025).

Then where the delay times are the same for chords A and B, it is known from equation (1) that:

$$c = \frac{L_A}{T_A - \tau} \tag{3}$$

(10/0025).

It follows from knowledge that the speed of sound for the medium is the same at both chord "A" and chord "B" that:

$$L_A (T_B-\tau) = L_B (T_A-\tau) \tag{4}$$

and

$$\tau = \frac{L_B T_A - L_A T_B}{L_B - L_A} \tag{5}$$

$\Delta L$ is defined as:

$$\Delta L = L_B-L_A \tag{6}$$

and it follows that:

$$\tau = \frac{L_B T_A}{\Delta L} - \frac{L_A T_B}{\Delta L} \tag{7}$$

with the variables being defined as above (10/0026).

Of course the transducer delay time for chord A, $\tau_A$, and the transducer delay time for chord B, $\tau_B$, are not the same (10/0027). However, these delay times are routinely measured for each pair of transducers at the manufacturing stage before the transducers are sent into the field (10/0027). Since $\tau_A$ and $\tau_B$ are known, it is also well known and common practice to calibrate each meter to

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[2] The concept of determining the presence of a measurement error must be distinguished from the idea of minimizing the chances of an error, or of minimizing the magnitude of the error. Only determining the *presence* of the error indicates if, in fact, the error exists in the measurement.

factor out transducer delay times for each ultrasonic signal. Effectively, $\tau_A$ and $\tau_B$ are then equal to zero and therefore the same. The only remaining component to transducer delay time is a misidentification of the arrival times for the ultrasonic signals as by peak selection errors. Since the measured transit time T is defined as the actual transit time, t, plus delay time, $\tau$, actual transit time can be substituted for measured transit time T where there is no peak selection error to result in:

$$\frac{L_B t_A}{\Delta L} - \frac{L_A t_B}{\Delta L} = 0 \qquad (8)$$

(10/0027).

This equation can then be used as a diagnostic to establish whether an error exists in the peak selection. It is equation (8) that has general applicability to a broad range of ultrasonic meters and signal arrival time identification methods (11/0028). Further variants and refinements of this idea are thereafter explained the application, with variations to the disclosed methods being within the skill of the artisan of ordinary skill.

## Prior Proceedings

In an office action dated September 16, 2003, the Examiner rejected claims 10-12, 14, 17, and 19-21 as obvious in light of *Motegi*. Claims 10 and 20 are the independent claims, with the third element of claim 20 being drafted in "step-for" format under the sixth paragraph of 35 U.S.C. § 112.

With respect to claim 10, in the office action of September 16, 2003 the Examiner stated:

> *Motegi* discloses an ultrasonic metering system, comprising: a first transducer pair defining a first ultrasonic path having a first path length (abstract, fig. 1, unit 3); a second transducer pair defining a second ultrasonic path having a second path length (col. 8, lines 14-23); one or more processors associated with said first and second transducer pairs (fig. , unit 19), said one or more processors suitable to determine a first transit time measurement for ultrasonic signals across said first ultrasonic path and a second transit time measurement for ultrasonic signals across said second ultrasonic path (fig. 2, 3, 5), wherein said processor is programmed to identify simultaneously measurement errors in said first and second transit time measurements (fig. 8, col.

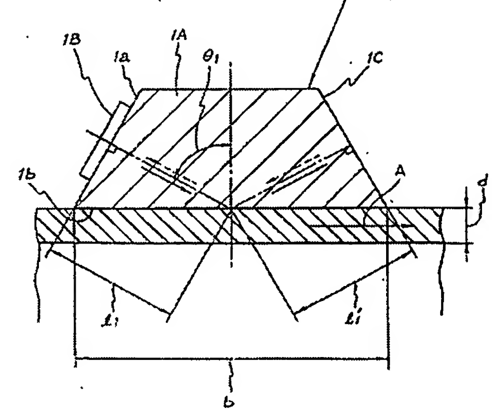
Lines 14-23).

Regarding claim 20, the Examiner stated:

> *Motegi* discloses a method to determine transit time measurement errors in an ultrasonic meter, comprising a) measuring a first transit time for one or more ultrasonic signals along a first path in a pipeline (col. 2, lines 55-63); b) measuring a second transit time for one or more ultrasonic signals along a second path in said pipeline (col. 2-3, lines 64-25), said second path being of different length than said first path (col. 8, lines 14-23); c) a step for determining transit time measurement errors in an ultrasonic meter (fig. 7).

This response followed.

FIG. 3




**U.S. PATENT 4,930,358 (Motegi et al)**

*Motegi* discloses a method of and an apparatus for measuring the flow velocity by ultrasonic waves by mounting ultrasonic transducers on the outside surface of a portion of piping (col. 1, lines 10-14 of *Motegi*). The problem confronted by *Motegi* is described by reference to Figure 5 of *Motegi*, below.

FIG. 5

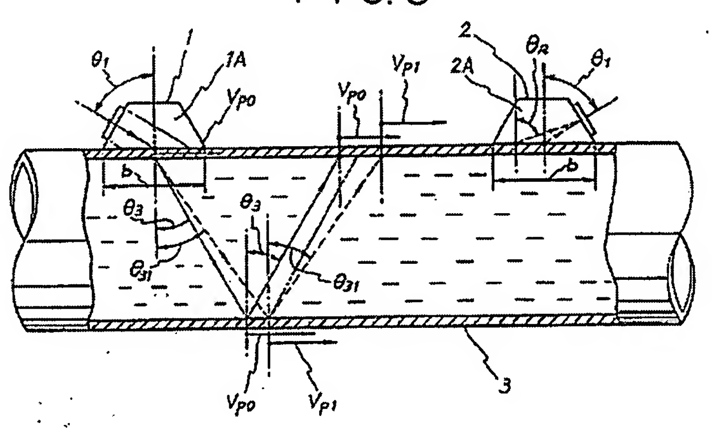
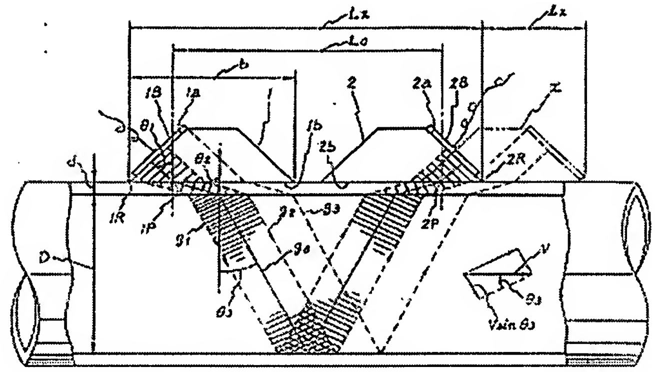


Figure 5 shows the conventional example addressed by the *Motegi* invention. The ultrasonic wave enters into the piping 3 at an angle $\theta_1$ from the ultrasonic transducer 1 and is propagated into the piping 3 with the spreading of 3 degrees or more to the center angle of refraction $\theta_3$. It is reflected at the inner wall on the opposite side or radiated against and propagated to the ultrasonic transducer on the receiving side. When the angle of incidence having spreading is close to the excitation condition of the resonance mode (lamb wave) of the piping, there is a tendency that the lamb wave $V_{p0}$ is generated in the piping wall portions of the ultrasonic transducer 1. At the same time, along with the propagation of the lamb wave $V_{p0}$, the leaking wave is radiated in a specific direction in the piping 3, e.g. $\theta_{31}$. This leaking propagation wave is reflected at the wall surface on the opposite side or is again radiated. As a result, the piping wall portion of the piping 3 on the receiving side also receives the component of the ultrasonic wave being propagated from the direction of $\theta_{31}$ in the fluid in the piping 3, so that, generally, the angle of refraction of the received wave is different from the direction $\theta_3$ initially expected by Snell's law. *Motegi*, col. 7, lines 17-41; *also see* col. 1, line 44; col. 1, line 55 – col. 2, line 15; col. 2, lines 16-21; col. 2, lines 22-26. Where the receiver is set to detect the highest value of the received waveform, the receiver may mistakenly detect the resonance modes instead of the ultrasonic signal that traveled through the fluid flow.

F I G. 4



A closer view of the ultrasonic vibration element and wedge member may be seen by reference to Figure 3, *supra*. *Motegi* explains that when an opening of the vibration element 1B is lengthened beyond an extent and the length b of the plane of incidence 1b has the length of about 18 wavelengths or more, the angle of directivity becomes very small, so that the ultrasonic wave beams being propagated in sequence in the wedge member, the wall portion of the piping, and the fluid in the piping can be regarded as generally parallel beams. *Id.* at col. 4, lines 42-49. *Motegi* further explains that the 18 wavelength figure was found by equation and confirmed experimentally. *Id.* at col 8, lines 14-28.

## ARGUMENTS

Appellants respectfully submit that the Examiner erred in rejecting claims 10-12, 14, 17 and 19-23 under 35 U.S.C. 103(a) because the Examiner has NOT adequately supported the rejection from knowledge generally available to one of ordinary skill in the art at the time of the invention, established scientific principles, or legal precedent established by prior case law. *Cf.* MPEP 2144; *In re Fine*, 5 USPQ2d 1596 (Fed. Cir. 1988); *In re Jones*, 21 USPQ2d 1941 (Fed. Cir. 1992); *Ex parte Clapp*, 227 USPQ 972 (Bd. Pat. App. & Inter. 1985). In particular, Appellants respectfully contend that the 35 U.S.C. 103 rejections are in error because *Motegi* does not teach identifying measurement errors in the first and second transit time measurements, or provide any motivation present from the prior art why or how *Motegi* would be modified to accomplish such a result. With regard to claim 20, the Examiner also fails to analyze the claim under a 35 U.S.C. 112, sixth paragraph construction.

### I. CLAIM 10

Claim 10, in shorthand, requires *two* transducer *pairs*, and one or more processors that identifies simultaneously *measurement errors* in two transit time measurements. Claim 10 requires at least *four* transducers and *two* transducer paths. As amended, claims 10 also requires the path lengths to be different.

The Examiner posits that a reference to a first transducer *pair* may be found in the abstract and at reference 3 in Figure 1. This is not accurate. Unit 3 is *piping* (col. 1, lines 41-43 of *Motegi*) not a pair of transducers. Further, while the abstract does describe a first transducer pair, it is the same pair that the Examiner indicates as the *second* transducer pair.

The Examiner's contends that *Motegi* discloses a second transducer pair (with a second path

length) at column 8, lines 14-23. Quoting the cited passage from *Motegi*:

> In FIG. 8, the relationship between the sizes (lengths) of the opening surfaces of the transducers 1 and 2 and the errors in the measured values which are calculated in terms of the flow velocity in the case of the specific flow rate measuring is experimentally surveyed in addition to the series of studies as described above. According to the results of the experiments, the size of the opening surface of radiation was b $\geq$ 15 $\lambda$ and the errors were 1.5% or less.

(*Motegi*, col. 8, lines 14-23).

This is not a *second* transducer pair. Transducers 1 and 2 are the same (and only) transducer pair disclosed by *Motegi*. *Motegi* shows in Figure 4 the operation of two transducers mounted on the outside surface of piping.

With regard to two transmission *paths*, as opposed to two transducer pairs, Figure 2 of *Motegi* shows signals from an upstream and a downstream travel path, but Figure 4 of *Motegi* shows that they travel along the same path (and in fact they must be from the same path if fluid flow is being measured). There is another "path" for ultrasonic signal transmission through the pipes, but this path does not correspond to a second pair of transducers. In fact, detection of the signals from this second path is a problem *Motegi* is trying to eliminate via the invention.

*Motegi* does not, and can not, *identify* errors in measurement as required by claims 10. The Examiner contends that *Motegi* teaches a processor programmed to identify measurement errors in first and second transit time measurements, citing to column 8, lines 14-23 of *Motegi*. In addition to the failure to have first and second transit time measurements corresponding to first and second transducer *pairs*, the cited passage of col. 8 simply does not teach a processor programmed to identify errors in the first and second transit time measurements corresponding to first and second transducer pairs.

The invention disclosed in *Motegi* is drawn toward a wholly different problem, and his solution is wholly different from the claimed invention as well. *Motegi is* applicable to a single

pair of ultrasonic transducers that are mounted on piping. Nowhere does *Motegi* teach the necessity for two transducer *pairs. Motegi* describes a method and related apparatus with two ultrasonic transducers, in each of which a considerably small angle of directivity is formed, provided on the upstream and downstream sides of a piping. The ultrasonic waves are made to alternately and obliquely enter the piping though the outer wall so as to measure sound velocities in the ultrasonic wave transducers at the time of measurements (col. 3, lines 3-12).

*Motegi* discusses changes to the physical construction of a meter to reduce the possibility of a spurious signal, but if such a spurious signal is detected *Motegi* would not identify it as such. The passage of *Motegi* at col. 8, cited by the Examiner, discusses a correlation between the lengths of the ultrasonic transducers and errors in the measured flow velocity. As disclosed at col. 1, ll 12-14, this error arises from mounting ultrasonic transducers on the outer surface of a portion of piping. But nowhere does *Motegi* disclose identifying the presence or magnitude of this error. As disclosed by *Motegi*, Figure 8 is a chart showing the spreading of the received wave when the angle of spreading and the directivity characteristics are small. As repeatedly emphasized by *Motegi*, the data of Figure 8 comes from experiments[3]. *Motegi* does not enable an apparatus that can make the measurements of Figure 8. First, the *Motegi* reference does not teach any apparatus for detecting errors to generate a table such as that shown in Figure 8. Second, if *Motegi* could establish the error in any given measurement the errors would be wholly compensated for by calculation – *Motegi* would not state in his patent that the errors are only "satisfactorily reduced" at column 8, line 28. The *Motegi* patent clearly states that the errors of Figure 8 were found *experimentally*, not by the invention itself. As can be appreciated by a careful reading of *Motegi*, the

[3] It is known to those of ordinary skill in the art to establish the accuracy of an ultrasonic meter design in a test facility, under controlled conditions (including knowledge of the flow rate through the ultrasonic meter).

*Motegi* invention is concerned with the *minimization* of errors, not detecting their presence or absence, or their magnitude

None of the cited passages or Figures appear to relate to peak measurement errors, or how to determine whether a peak measurement error exists.

In addition, the dependent claims contain features that are independently patentable.

## II. CLAIM 20

The Applicant respectfully submits that the Examiner has failed to make a *prima facie* case of obviousness for claim 20. Claim 20 recites in part "a step for…", an element drafted in 35 U.S.C. § 112(6) format. Yet the Examiner has not made any analysis under this section of the statute.

In addition, rejection of claim 20 fails because *Motegi* does not teach identification of errors in the ultrasonic signals.

## III. NEW CLAIMS

Claims 24-26 have been added. Claim 24 recites a difference in the first path length and the second path length, with the processor(s) identifying the measurement errors in the first and second transit time measurements by using the difference. This is not taught or suggested by *Motegi*. Claim 25 specifies that the error is a transit time arrival error. Claim 26 specifies that the errors are found simultaneously.

Allowance of all pending claims is respectfully requested.

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Respectfully submitted,

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